



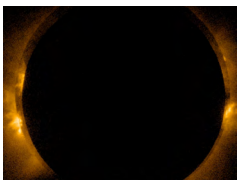
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The Marshall Star is published every Wednesday by the Public and Employee Communications Office at the George C. Marshall Space Flight Center, National Aeronautics and Space Administration. The Star does not publish commercial advertising of any kind.

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## Marshall Center, North Alabama Companies Play Big Part in Orion's First Flight

*By Megan Davidson*

NASA's Orion spacecraft is set to launch from Cape Canaveral Air Force Station in Florida on Dec. 4 aboard a Delta IV Heavy rocket for a trip that will take it 3,600 miles above Earth's surface -- a historic journey that also will take with it the hearts and hard work of people right here in the Tennessee Valley.

During Orion's uncrewed test flight, several key systems will be tested: abort systems integration; computer and

guidance systems designed to sustain a crew during space travel; and the heat shield and other critical landing systems that provide safe return to Earth. Flight data will influence future design decisions, validate existing computer models and innovative new approaches to space systems development, as well as reduce overall mission risks and costs.

Teams at NASA's Marshall Space Flight Center have provided critical support

*See Orion's First Flight on [page 2](#)*

## Marshall Technology Exposition Showcases Emerging Technologies, World-class Capabilities of Center, Agency

*By Chris Blair*

On Oct. 27, the Marshall Technology Exposition -- showcasing the emerging technologies and world-class capabilities developed by the [Marshall Space Flight Center team](#) -- was held at the Davidson Center for Space Exploration at the U.S. Space & Rocket Center.

The event drew over 550 attendees from industry, academia and other

government agencies and featured more than 40 exhibits showcasing Marshall's heritage and contribution to space exploration, science and technology mission and future space exploration goals.

Panel discussions topics included applied technologies for exploration and emerging space technology

*See Technology Expo on [page 3](#)*

## Orion's First Flight *Continued from page 1*

ahead of Orion's flight. Marshall has fabricated almost 1,000 pieces of Orion flight and ground test hardware; conducted structural testing of the service module and crew module elements; and managed oversight of the launch abort system propulsion elements.

"Marshall and all of North Alabama should be very proud of the contributions that we have made to this mission, especially the complex launch abort system designed to enhance crew safety," said Larry Gagliano, Marshall's deputy project manager for the Orion Launch Abort System. "A tremendous amount of effort from many folks in the area have helped ensure NASA's deep space missions will be successful."

The launch abort system, positioned atop the crew module, is designed to activate within milliseconds on future missions to propel the crew module to safety in the event of an emergency during launch or climb to orbit.

The Orion fabrication and testing work at Marshall was a collaborative effort under a Space Act Agreement with Orion prime contractor Lockheed Martin. Several Huntsville-area companies also provided flight hardware and ground support equipment, including Arcata Associates Inc., InfoPro Corporation, Teledyne Brown Engineering and General Products.

"We are thrilled to be working with NASA and the various contractor teams in preparation for this major milestone for Orion," said Terry Abel, project manager at Lockheed Martin. "We look forward to a successful launch and reviewing the flight test data that will benefit future missions."

### **Adapter Technology and the Delta IV**

The stage adapter that will connect the Orion to the Delta IV Heavy for the flight was designed, built and tested at Marshall. Marshall also conducted pressurized testing for the adapter diaphragm -- which will keep gases away from the spacecraft.

"Our expertise was especially critical in building the adapter technology to connect Orion to the launch vehicle and in developing propulsion elements of the launch abort system," said Chris Singer, director of Marshall's Engineering Directorate.

Orion will be integrated with a Delta IV Heavy, a rocket built and operated by United Launch Alliance in nearby Decatur. In early October, ULA engineers, technicians



*The Orion spacecraft undergoes assembly operations in early October inside the Launch Abort System Facility at NASA's Kennedy Space Center. The Marshall Center, Lockheed Martin and other North Alabama companies have provided critical support on the launch abort system and other key components of the spacecraft, as well as the stage adapter, ahead of Orion's first flight in December. (NASA)*

and representatives from safety, quality, security and other groups also ensured that the launch vehicle arrived safely at Cape Canaveral Air Force Station Space Launch Complex 37 ahead of the December launch.

"ULA is honored to have manufactured the Delta IV Heavy rocket that will launch Orion on its flight test," said Craig Langford, ULA vice president of Production Operations. "We understand the importance of this ground breaking mission and the insights it will offer for the future of human spaceflight."

Orion's flight test will provide engineers with important data about the adapter's performance and prepare Orion for future destinations aboard NASA's Space Launch System. When completed, SLS will be the most powerful rocket ever built for deep space missions, including to an asteroid and ultimately Mars. Marshall manages the SLS Program for the agency.

*Davidson, an ASRC Federal/Analytical Services employee, supports the Office of Strategic Analysis & Communications.*



## Technology Expo *Continued from page 1*

developments -- highlighting innovative research in the fields of propulsion, space environments, avionics, advanced manufacturing and more.

"It's important to hold forums like this that allow us to network and build strong relationships with our industry, academia and government partners," said Jody Singer, manager of the Flight Programs and Partnerships Office at the Marshall Center. "Outside partnerships advances NASA's missions, strengthens the U.S. economy and leverages resources to create a mutually beneficial relationship."

One new highlight at this year's expo was the Destination Station: ISS Technology Forum -- the second in a series of live, interactive discussions about how the [International Space Station](#) is a test bed for the technologies needed to explore deep space destinations. Space station representatives engaged the audience in conversation, while answering questions about the station's role in the development of future exploration technologies.

Moderators, panelists and guest speakers at the expo included scientists, engineers and astrophysicists from Marshall and other NASA field centers, as well as representatives of the contracting workforce. Key remarks and presentations were provided by Marshall Center Director [Patrick Scheuermann](#); Dr. Michael Gazarik, associate administrator of [NASA's Space](#)



*The Marshall Technology Expo featured many panel discussions and guest speakers, including the Destination Station: ISS Technology Forum -- one in a series of live discussions about how the International Space Station is a test bed for technologies needed to explore deep space destinations. Participating in the forum are, from left, Niki Werkheiser, project manager with NASA 3D Printing in Zero-G; Richard C. Reinhart, principle investigator with SCaN Testbed; Jose Benavides, chief engineer with SPHERES National Lab Facility; Robyn Gatens, System & Technology Demonstration manager; Jeffrey Sheehy, senior technologist, Space Technology Mission Directorate; and Dan Huot, public affairs specialist, Johnson Space Center. (NASA/MSFC/Emmett Given)*

[Technology Mission Directorate](#); [Dr. David Miller](#), NASA chief technologist; and [Johnny Stephenson](#), deputy director of the Marshall Center's Office of Strategic Analysis & Communications.

For more than 50 years, the Marshall Center has advanced NASA's scientific and technological discoveries, while developing a broad portfolio of in-house testing capabilities. Teamwork and partnership around the center has been at the heart of those advancements and accomplishments.

Marshall capabilities support every stage of spacecraft and launch vehicle development and operations. Expert teams at Marshall develop, test and evaluate aspects of materials, systems and vehicles, including the [Space Launch System](#) -- NASA's next generation rocket designed for deep space exploration beyond Earth's orbit.

For more information about this event, please visit the [Marshall Technology Expo](#) webpage.

To learn how to do business with NASA and the Marshall Center, please visit the [NASA Office of Small Business Programs](#) webpage.

*Blair, an ASRC Federal/Analytical Services employee, supports the Office of Strategic Analysis & Communications.*



*During the Marshall Technology Expo, held at the Davidson Center for Space Exploration, hundreds of participants -- including area high school students -- visited dozens of booths and exhibits showcasing emerging technologies and in-house capabilities of the Marshall Center. Expo participants included NASA team members, along with aerospace professionals from government, industry and academia, all interested in advancements with propulsion, avionics, advanced manufacturing and more. (NASA/MSFC/Fred Deaton)*

# 7th Annual Wernher von Braun Symposium Highlights NASA Research and Technology

NASA Associate Administrator of Education [Donald James](#) moderates one of the many panel discussions during the 7th annual Wernher von Braun Memorial Symposium, held in Huntsville Oct. 27-30. The symposium -- recognized for shaping the U.S. space program -- featured panel discussions, guest speakers and updates on the [International Space Station](#), [Orion](#) and the [Space Launch System](#). The symposium brought NASA, business contractors and academia officials together to discuss future perspectives on space exploration, commercial initiatives, trends within engineering and shaping space policy. (NASA/MSFC/Emmett Given)



In addition to attending the Von Braun Symposium, NASA Administrator [Charles Bolden](#) visited the [Marshall Center's](#) Payload Operations Integration Center -- where NASA plans and oversees on-orbit science investigations. There, Bolden spoke with NASA astronauts [Butch Wilmore](#) and [Reid Wiseman](#), aboard the [International Space Station](#). Wilmore -- a Mt. Juliet, Tennessee, native who assumes space station command for [Expedition 42](#) in November -- spoke with Bolden about the completion of science investigations, spacewalks, and his remaining five months on the space station. Reid is scheduled to depart station and return to earth on Nov. 9. (NASA/MSFC/Emmett Given)

## Marshall Center's NTREES Facility Tests 'Ticket to Mars' Technologies

By Rick Smith

Nuclear Thermal Propulsion technologies are the subject of a new test series at NASA's Marshall Space Flight Center. Researchers are using an innovative test facility to study the properties of highly promising nuclear fuels without the risk of radiation exposure associated with handling these potent power sources. The current test series -- focused on analysis of a variety of fuel elements in a simulated thermal environment -- kicked off in early October with completion targeted for June 2015.

Michael Houts, Nuclear Thermal Propulsion manager at Marshall, said the safety factor is good news for scientists and technologists developing the technology -- and the

advances enabled by the study will yield even better news for flight engineers and NASA mission planners. Nuclear thermal rockets "may be ideal to enable delivery of very large, automated cargo payloads to Mars, paving the way for human explorers," he said.

The focus on safety extends beyond the laboratory to the launch pad, Houts noted. A chemically powered launch vehicle, such as NASA's next flagship, the Space Launch System, could safely carry a nuclear-thermal-powered upper stage to orbit. During ascent to orbit, the nuclear system would remain "cold," with no fission products generated and radiation below significant levels.

See *NTREES* on [page 5](#)



The same nuclear thermal propulsion technology, reconfigured for speed rather than mass, then could potentially transport human crews to the Red Planet as well, which would get them there more quickly and efficiently than conventional rockets while reducing astronauts' solar radiation exposure during the voyage.

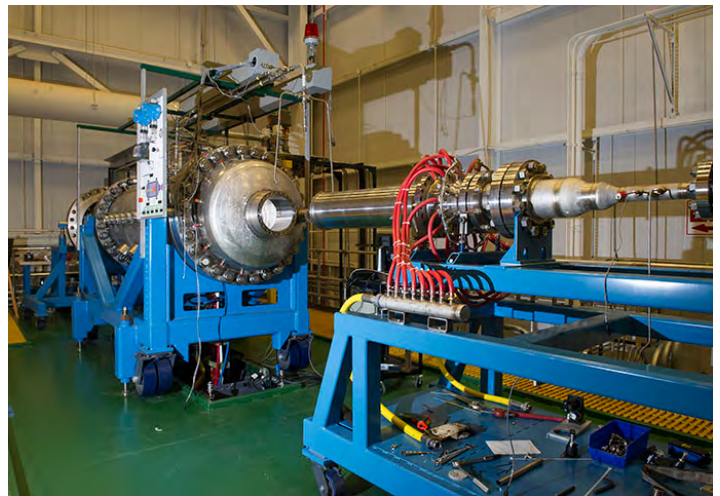
In short, Houts said, "Nuclear thermal propulsion could be the ticket to Mars. The results from this study will give us a better idea of whether that is the case by experimentally measuring key factors related to engine performance and lifetime."

Housed in Marshall's Propulsion Research and Development Laboratory, the test facility used for these innovative studies is dubbed "NTREES," short for the Nuclear Thermal Rocket Element Environmental Simulator. Licensed by the Nuclear Regulatory Commission, the facility is certified to test prototypical nuclear rocket fuel elements. These are identical to the fuel elements used in a nuclear thermal rocket, but because the test facility uses non-nuclear heating instead of nuclear fission, the fuel does not become radioactive during the test and can be easily handled and examined once the test is complete.

NTREES safely tests these stand-in, prototypical fuel elements in hot flowing hydrogen at power levels and temperatures comparable to those found in a working nuclear thermal rocket engine. Induction heating is used to mimic the fission process, with pressures reaching 1,000 pounds per square inch and temperatures approaching 5,000 degrees Fahrenheit.

"The cost savings is remarkable," said Marshall researcher Bill Emrich, who manages the NTREES facility. "Whereas it costs tens of millions of dollars to perform full-scale testing of nuclear rocket fuel elements in specially designed nuclear reactors, our research costs just tens of thousands -- and no radiation protection is required."

Houts concurred. "By using this non-nuclear induction heating process for testing, we avoid the environmental and security issues associated with performing full-powered nuclear tests -- and advance this research far more quickly than we could do otherwise," he said. "And when, in time, we conduct actual nuclear testing, we will have very high confidence that those tests will be successful, thanks to these initial, non-nuclear studies."



*The NTREES test facility at the Marshall Center safely tests simulated nuclear fuel elements, which reduce risk and costs associated with advanced propulsion technologies. Such technology could propel human explorers on deep-space exploration more efficiently than conventional spacecraft while reducing crew exposure to the harmful space environment. (NASA/MSFC/Emmett Given)*

Once safe orbit was achieved, the upper stage would deploy, and its nuclear reactor would be activated, heating hydrogen to extremely high temperatures. The hydrogen then would expand through a nozzle, generating thrust.

Such an engine is expected to operate twice as efficiently as a standard chemical engine, Houts said. The space shuttle main engine, which powered space shuttle missions to Earth orbit for 30 years and is generally considered one of the best, most efficient chemical engines ever built, delivered a specific impulse of 450 seconds. A nuclear thermal rocket, in comparison, would deliver a specific impulse of 900 seconds. That dramatic increase in efficiency could enable reliable delivery of high-mass automated payloads into the deep solar system, or help high-velocity, human-rated vehicles speed to and from Mars and other destinations in as little as half the time required by today's rockets.

Right now, though, NTREES research is driven by one critical goal: enabling a human mission to Mars. The current round of testing lays the groundwork for large-scale ground tests and eventual full-scale testing in flight.

*Smith, an ASRC Federal/Analytical Services employee, supports the Office of Strategic Analysis & Communications.*

# Space Launch System Booster Separation Testing Brings Confidence to First Flight

By Sasha Congiu

3, 2, 1 liftoff!

It's a familiar phrase heard just before a rocket launches at NASA's Kennedy Space Center or Cape Canaveral Air Force Station. Throughout history, millions have traveled from across the world to see the fiery plumes created by a rocket's large boosters, which have launched astronauts and other payloads into space time and time again.

NASA will once again shape history when it launches the Space Launch System.

Engineers at NASA's Langley Research Center are doing their part to enable NASA's 5.5-million-pound SLS to launch the Orion spacecraft to deep space. To understand the aerodynamic forces exerted on the rocket as it flies through the atmosphere, Langley engineers recently tested a 35-inch SLS booster separation model in its Unitary Plan Wind Tunnel, with air speeds of over 2,400 mph. The engineers collected high-fidelity data from 800 runs.

SLS will be the world's most powerful rocket, capable of carrying a crewed Orion, as well as important cargo, equipment and science experiments, to deep space destinations. NASA's Marshall Space Flight Center manages the SLS Program for the agency. Orion will serve as the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain the crew during the space travel and provide safe re-entry from deep space return velocities.

Just over two minutes into the first flight of SLS, 16 booster separation motors will fire simultaneously and safely push the two solid rocket boosters away from the rocket's core. As the core stage continues to travel at a speed greater than four times the speed of sound, the boosters re-enter Earth's atmosphere and land in the Atlantic Ocean.

"Booster separation is a very critical phase of flight for the Space Launch System because the clearance between the core stage and the boosters is very small as they are pushed away," said Langley engineer Jeremy Pinier. "It's only about an inch full-scale so the boosters are almost grazing the core stage, but we can't allow any contact whatsoever between the two in the real flight."

The wind tunnel test, which validates an accurate



Bryan Falman, a test engineer from NASA's Langley Research Center, observes the Space Launch System booster separation 32-inch model after three weeks of testing it in Langley's Unitary Plan Wind Tunnel. (NASA/David C. Bowman)

clearance, was unlike any other.

"It's a pretty complex wind tunnel test," Pinier said. "Usually we measure aerodynamic forces on a single model in the test section. Here we have three -- the core and two solid rocket boosters -- which makes it three times as difficult. We are also flowing very high-pressure air through the booster separation motors, which is pretty unique, and an added challenge."

Due to the inherent complexity of the model design, test setup, tunnel operations and multi-dimensional parameter space, engineers spent four weeks installing the model into the tunnel prior to testing.

"We had to make sure we controlled exactly the positioning of the three bodies relative to each other," Pinier explained. "At these small scales, we have to know within thousandths of an inch how well the model is positioned because when you translate it to a full scale distance, it immediately matters."

With the successful completion of installation and testing of the SLS model, Pinier couldn't help but reflect on how grateful he is for the opportunity. "I have my dream job," he said with a big grin on his face.

*Congiu is a public affairs officer at NASA's Langley Research Center.*

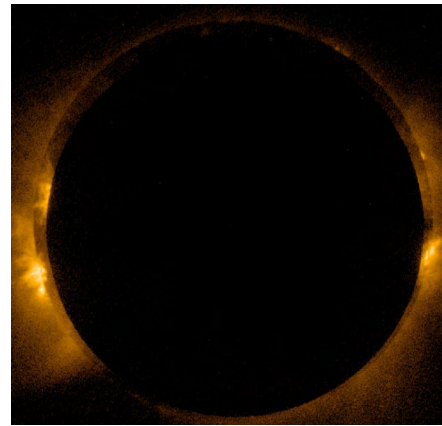
# Hinode Captures Images of Partial Solar Eclipse

A partial solar eclipse was visible from much of North America before sundown Oct.23. A partial eclipse occurs when the moon blocks a portion of the sun from view.

The Hinode spacecraft captured images of the eclipse as it passed over North America using its [X-ray telescope](#). During the eclipse, the new moon eased across the sun from right to left, with the sun shining brilliantly in the background. And as a stroke of good luck, this solar cycle's largest active region, which has been the source of several large flares over the past week, was centered on the sun's disk as the moon transited.

Hinode is in the eighth year of its mission to observe the sun. It has observed numerous eclipses due to its high-altitude, sun-synchronous orbit. As viewed from Hinode's vantage point in space, this eclipse was annular instead of partial, which means that the entire moon moved in front of the sun but did not cover it completely. In this situation, a ring of the sun encircles the dark disk of the moon.

Led by the Japan Aerospace Exploration Agency, the Hinode mission is a collaboration between the space agencies of Japan, the United States, the United



*The partial solar eclipse as viewed from Hinode's vantage point in space. (NASA/JAXA/SAO)*

Kingdom and Europe. NASA helped in the development, funding and assembly of the spacecraft's three science instruments.

Hinode is part of the Solar Terrestrial Probes Program within the Heliophysics Division of NASA's Science Mission Directorate. NASA's Marshall Space Flight Center manages the Hinode science operations. The Smithsonian Astrophysical Observatory is the lead U.S. investigator for the X-ray telescope.

## Marshall Team Encouraged to Attend Surviving an Armed Violent Encounter Training to Learn About Workplace Violence

A workplace violence prevention awareness class is now being offered at NASA's Marshall Space Flight Center.

The Surviving an Armed Violent Encounter, or SAVE, training is a four-hour, hands-on seminar where attendees will learn what to do if faced with a critical incident of violence at work.

The class is designed for all Marshall team members, especially supervisors, managers and human resource specialists. Everyone is encouraged to attend.

"This is a great training opportunity in which all can benefit," said Diana Simpson, Marshall's workplace violence prevention program coordinator in the Protective Services Office. "Participants will examine previous workplace violence incidents, learn the behavior of offenders, and practice verbal and physical tactics to survive a critical incident of violence in the workplace."

"Everyone wants to be safe in their work environment," she added. "The key to preventing a violent situation from occurring is 'Awareness+Action = Prevention.' This seminar will increase the participants' knowledge on what actions to take before and/or during a dangerous event."

Morning or afternoon sessions will be in Building 4627 on Nov. 5, 8 a.m.-noon; Nov. 6, noon-4 p.m.; Nov. 12, 8 a.m.-noon; and Nov. 13, noon-4 p.m.

The training also includes voluntary physical skill drills and practical exercises to overcome conflicts in the office environment. Participants should wear clothing and footwear suitable for physical activity if one plans to take part in the physical activities.

Team members can sign up for the training through [SATERN](#). For questions, contact Shawn Jayne, training coordinator, at 544-1961 or at [shawn.d.jayne@nasa.gov](mailto:shawn.d.jayne@nasa.gov).



## CFC: Marshall Team Supports CASA Client Services, Special Olympics

On Oct. 17, employees from NASA's Marshall Space Flight Center volunteered with CASA of Madison County -- a Huntsville-based charity that provides support for area individuals -- to build a wheelchair ramp for a person in need. The event was in support of the Combined Federal Campaign, an annual workplace charity campaign. CASA provides needed services to aging or homebound individuals, allowing them to remain in their homes. From left are Marshall team members Melody Mayle, Scott Stevens, Victor Pritchett, Darren Reed and Brandon Mobley. Also volunteering were Marshall's John Blevins, Stewart Nelson and Andy Herron. (NASA/MSFC/Emmett Given)



Marshall Center Director Patrick Scheuermann applauds as the torch is raised to signify the start of the Special Olympic games Oct. 22 at Huntsville's Milton Frank Stadium. As part of the Combined Federal Campaign benefitting area charities, Marshall team members volunteered to escort the athletes and show their support. The Special Olympics enables children and adults with developmental disabilities to participate in fun and engaging sports training and athletic competitions. (NASA/MSFC/Emmett Given)

## NASA's Space Launch System Rocket Welding Featured on NASA-TV

The loading of the first ring and barrel segments of the core stage for NASA's [Space Launch System](#) rocket is featured in the latest edition of "[This Week @NASA](#)," a weekly video program broadcast nationwide on NASA-TV and posted online.

The segments were loaded onto the Vertical Assembly Center tool at NASA's [Michoud Assembly Facility](#), managed by the [Marshall Space Flight Center](#). The Vertical Assembly Center -- the world's

largest spacecraft welding tool -- is designed to weld together the various segments of the core stage. These are the first confidence welds made, which ensures that it works as expected before welding actual flight hardware for the agency's new deep space exploration rocket, the [Space Launch System](#).

This and previous episodes of "[This Week @NASA](#)" are available for viewing at the [NASA-TV YouTube channel](#).



## Obituaries

**Mildred Smith Wilkerson**, 69, of Arab, Alabama, died Sept. 22. She retired from the Marshall Center in 2003 as a configuration management specialist. She is survived by her husband, Cecil T. Wilkerson.

**Thomas Clayton Shaw**, 84, of Jacksonville, Alabama, died Sept. 25. He retired from the Marshall Center in 1985 as an electronics technician. He is survived by his wife, Fumiko Shaw.

**Robert Devenish**, 97, of Huntsville, died Sept. 25. He retired from the Marshall Center in 1984 as a facilities and equipment specialist.

**Brenda Jean Roberts Sutherland**, 67, of Somerville, Alabama, died Sept. 30. She retired from the Marshall Center in 2005 as a data manager for technical operations. She is survived by her husband, Robert Lee Sutherland.

**Garland D. Johnston**, 85, of Huntsville, died Oct. 5. He retired from the Marshall Center in 1994 as an aerospace engineer.

**Beodric Cogbill**, 94, of Huntsville, died Oct. 7. He retired from the Marshall Center in 1980 as a supply clerk.

**Robert Eugene Lavender**, 88, of Fairfield, Alabama, died Oct. 9. He retired from the Marshall Center in 1978 as an aerospace engineer. He is survived by his wife, Elizabeth Thompson Lavender.

**John Emmitt Shirey**, 85, of Huntsville, died Oct. 18. He retired from the Marshall Center in 1981 as assistant director for energy conservation. He is survived by his wife, Geraldine Francis Shirey.